General information	
Academic subject	General and Inorganic Chemistry (Module of Chemistry-Integrated course)
Degree course	Natural Sciences (I level)
Academic Year	*I year*
European Credit Transfer and Accumulation System (ECTS)	6
Language	*Italian*
Academic calendar (starting and ending date)	*2021/2022 (October 2021-January 2022)*
Attendance	*Yes*

Professor/ Lecturer	
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Tutoring (time and day)	Monday, Wednesday, Friday 15-18 by appointment

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Syllabus	
Learning Objectives	The topics introduced in the course provide the basis for understanding the properties of atoms and molecules and their relationship with the macroscopic properties of matter. The student will be able to understand the fundamental properties of the elements, the structure and properties of molecules, the properties of gases and solutions, as well as the basic principles of chemical reactivity. The main knowledge acquired during the course concerns the fundamentals of atomic and molecular theory; the phenomenological theory of ideal gases; the description of the solids; liquids and solutions; the foundations of classical thermodynamics, and the elementary thermodynamic description of chemical reactions; acid-base, redox and precipitation reactions, the fundamentals of electrochemistry, the elementary description of the periodic properties of the most important elements for biology; the simple experimental operations of the chemistry laboratory. The main skills concern the interpretation of the fundamental properties of the elements, the structure and properties of molecules; the execution of stoichiometric calculations; the calculation of the properties of gases and solutions; the calculation of the equilibria in aqueous solution and the calculation of the thermodynamic potentials; the description of the properties of the main group elements.
Course prerequisites	Elementary knowledge of physics, mathematics, algebra
Contents	Laboratory equipment. The SI system of Units of measurement. States of aggregation of matter, status changes. Homogeneous and heterogeneous systems. Definition of phase. Isolated, closed, open systems. Atoms and molecules. Elements and compounds. Atomic and molecular mass, Mole, Molar mass. The gaseous state: the ideal gas, the real gases. Properties of gases: experimental studies. General equation of state of the ideal gas. Kinetic theory, temperature and average energy. Boltzmann distribution law. (Kinetic gas model: gas state equation). Thermodynamic properties. Liquids. Ideal liquid and real liquids. Additiveness of volumes. Partial miscibility. Solutions: expression of the concentration of solutions. Solubility. Evaporation. Equilibrium Concept. Vapor pressure curves: experimental determination. Evaporation energy. State diagram of pure liquids: water, carbon dioxide. Two or more component systems. Raoult's

	law. Vapor pressure of two-component systems: Water status diagram for two-component systems. Colligative properties of solutions. Henry's law. Solid state. Structure of solids. (Crystalline lattices. Covalent, ionic, polymeric solids). The atom. Bohr model. Probabilistic theory. Orbitals: sequence of occupation of energy states. Ionization potential, electronic affinity. The Periodic Table. Periodic properties of the elements. Chemical bond: Valence Bond and LCAO theory. Bond in diatomic (LCAO) and polyatomic (VB) molecules. Structural formulas of elements and compounds. Oxidation state. Chemical reactions. Acid base and redox reactions. Reaction balance and stoichiometric calculations. Acids and bases: definition of Arrhenius, Broensted, Lewis. Strength of acids and bases. Acid and basic constants. Water self-protolysis: Kw. pH scale. Amphoteric substances. Buffer solutions. pH calculation of acids and bases solutions. Titrations and indicators. (Acid base and redox titrations: examples) Solubility product. (Influence of pH on solubility). Chemical kinetics: order of reaction. Electrochemical cell. Electrochemical potential. Nernst equation. Electrolysis. Chemistry of Group elements 1,2, 13-18. Transition elements. Laboratory exercises (8h): Observation of some reactive processes. Preparation of solutions; acid base and redox titrations; pH measurements
Books and bibliography	Principi di chimica (P. Atkins, L. Jones - Casa Editrice Zanichelli) Elementi di stechiometria (P. Giannoccaro, S Doronzo - Casa Editrice EdiSES
Additional materials	Integration with other books available in library and lectures notes

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
150	*40*	*8 (Lab) + 7 (numerical exercises)*	*95*
ECTS			
6	*5*	*1*	
Teaching strategy	The course, in the absence of limitations related to the pandemic situation and the availability of laboratories, is organized as follows: theoretical lessons in the classroom, study of theoretical issues in the classroom, resolution of numerical problems in the classroom, laboratory exercises carried out through the execution of guided experimental tests in the laboratory. Students are divided into small groups, each of which carries out the proposed experimental test independently. Before execution, the principles of the experiment are presented and discussed with the students. During the experiment, the various groups can consult a written guide that describes the various phases and operations that make up the experimental procedure.		
Expected learning outcomes			
Knowledge and understanding on:	• Acquisition of a solid and rigorous knowledge of the fundamentals of General and Inorganic Chemistry and of theoretical-operational tools for understanding chemical, biological and geological phenomena. Theoretical lessons and also numerical exercises in the classroom and laboratory will contribute to the achievement of these objectives. The level of knowledge acquired will be verified by the drafting of reports relating experiences carried out in the laboratory, and the evaluation test.		
Applying knowledge and understanding on:	• Ability to apply the acquired knowledge to chemical phenomena, to interpret them correctly and to know how to use the principles that govern them.		

	Ability to apply the acquired knowledge: -to solving problems and numerical exercises related to the topics covered in the course (conversion of units of measurement; stoichiometric calculation; concentration and colligative properties of solutions; equilibria in gaseous phase and in solution; electrochemistry; description of structure and reactivity of molecules). The skills acquired will be verified by conducting classroom exercises, and during the written / oral examination.
Soft skills	• *Making informed judgments and choices:* The student must demonstrate to have acquired aptitude for scientific reasoning and developed critical skills in the analysis of chemical phenomena and in the resolution of problems and exercises. The achievement of this objective will be verified by carrying out exercises in the classroom and during the written / oral examination. • *Communicating knowledge and understanding:* Acquisition of the correct terminology in the scientific and chemical field, acquisition of exhibition skills characterized by clarity and language properties. The student must be able to correctly expose definitions, fundamental concepts, theories concerning the contents of the course itself and to discuss clearly the problems presented to him. These skills will be evaluated during the oral examination. • *Capacities to continue learning:* Acquisition of the ability to investigate issues and topics related to the teaching discipline in an autonomous way through the consultation of texts, databases and scientific works available in the library or on the web and to identify the connections with other disciplines of the course of study. The acquisition of this ability will be verified by discussing the topics of the exam.

Assessment and feedback	
Methods of assessment	The student's evaluation criteria includes an oral test that will be preceded by a two-hour written test consisting of the resolution of four / five exercises or problems on topics covered in the course and questions regarding nomenclature, molecular geometry, redox reactions and titrations. Only those who pass the written test are admitted to the oral test.
Evaluation criteria	In the evaluation of the exam and in the assignment of the final grade, the following items will be taken into consideration: 1. *Knowledge and understanding:* insufficient, superficial, good, complete, excellent; 2. *Applying knowledge and understanding:* insufficient, discrete, good, excellent; 3. *Autonomy of judgment:* fair, good, excellent; 4. *Communicating knowledge and understanding:* confused and insecure; clear and correct; excellent and safe; 5. *Communication skills:* discreet, good, excellent; 6. *Capacities to continue learning:* discreet, good, excellent.
Criteria for assessment and attribution of the final mark	Other factors, such as the active participation of students in lectures and laboratory exercises, the work done individually by the student in the form of written reports on the laboratory exercises carried out will also be evaluated in a positive sense. The mark is thirty, with possible praise. Passing the exam implies the

	achievement of a grade not lower than 18/30 and involves the assignment of the corresponding university educational credits. A necessary condition for passing the exam is to have achieved a non-negative assessment in relation to points 1,2,4. To achieve a score of 30/30 cum laude, the student must have achieved a level of excellence relative to points 1-6.
Additional information	